

# FIXING DEVICE AND IMAGE FORMING APPARATUS HAVING THE SAME

[0001]

## BACKGROUND OF THE INVENTION

The present invention relates to a fixing device in use  
5 for an image forming apparatus of the electrostatic recording  
type, such as a copying machine, a facsimile or a printer.

[0002]

A conventional image forming apparatus based on an  
electrophotographic system operates in the following way. A  
10 photosensitive member as an image carrying body is charged by  
a charger. The charged photosensitive member is irradiated with  
light containing image information to thereby form a latent image  
on the photosensitive member. The latent image is developed,  
with a developing device, into a toner image. The toner image  
15 is transferred onto a recording medium to form or reproduce a  
picture on the medium.

[0003]

With colorization of the image, there is proposed a color  
image forming apparatus of the tandem type for forming a full  
20 color image. This type of the image forming apparatus is provided  
with a plurality of image forming units each executing the image  
forming process as mentioned above. Color toner images of cyan,  
magenta, and yellow, and preferably black are formed on  
photosensitive members provided for those colors. At transfer  
25 positions on the photosensitive members, those toner images are

superimposed one on another, and transferred onto an endless intermediate transfer body.

[0004]

The image forming apparatus of the toner image transfer  
5 type includes a fixing device. The fixing device contains a  
fixing nip part formed with a couple of rollers. The fixing  
nip part nips and transfers the recording medium. When the  
recording medium passes through the nip part, the toner image,  
not yet fixed, on the recording medium is fused under pressure,  
10 and is fixed on the recording medium. Since the fixing unit  
heats the toner for its fusing, temperature of the rollers is  
high.

[0005]

For example, it has proposed in JP-A-2001-249562.

15 [0006]

When the fixing device is detached from the image forming  
apparatus immediately after the printing operation ends, a  
message to inhibit the worker from touching the hot rollers is  
visually presented for the purpose of jamming removal or part  
20 replacement.

[0007]

However, it is inevitable that the worker will touch the  
hot rollers carelessly or accidentally. Accordingly, use of  
only the message is not sufficient for giving a sure warning  
25 to the worker.

[0008]

SUMMARY OF THE INVENTION

It is, therefore, an object of the invention to provide a fixing unit having a function to prevent the worker from touching the hot rollers in maintenance work and an image forming apparatus provided with the fixing device.

[0009]

To achieve the above object, there is provided a fixing device which nips and transports a recording medium by a fixing nip part defined by a couple of rollers installed in a housing, and fuses and fixes an unfixed toner on a recording medium. The fixing device is comprised of: a gripping part which is formed on the housing and may be gripped when the fixing device is handled; a medium introducing port which is formed near the gripping part of the housing, and to which a recording medium to be subjected to a fixing process is guided; and a shutter which is provided slanted at a given angle with respect to a gripping surface of the gripping part such that the shutter has a fulcrum at a part thereof closer to the gripping part at the medium introducing port, and is turnable to a position to close the medium introducing port while resisting the urging forces of urging means.

[0010]

With such a mechanical arrangement, when the user grips the fixing unit with his fingers to handle the fixing unit, the finger causes the shutter to turn to a position to close the

medium introducing port. Accordingly, the finger cannot enter the inside of the fixing unit and, hence, in handling the fixing unit, the user never touches the hot roller or rollers.

[0011]

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram schematically showing an arrangement of an image forming apparatus equipped with a fixing unit which is constructed according to the present invention;

10 Fig. 2 is a cross sectional view showing an inner construction of the fixing unit which is an embodiment of the invention;

Fig. 3 is a cross sectional view showing a key portion of the fixing unit of the embodiment of the invention;

15 Fig. 4 is a cross sectional view showing a key portion of the fixing unit of Fig. 3 in a state that it is attached to the image forming apparatus;

Fig. 5 is a cross sectional view showing a key portion of the fixing unit of Fig. 3 when the fixing unit is handled;

20 Fig. 6 is an overall perspective view showing how the fixing unit, which is the embodiment of the invention, is attached to and detached from the image forming apparatus;

Fig. 7 is a perspective view showing the overall fixing unit which is the embodiment of the invention;

25 Fig. 8 is a cross sectional view taken on line 8 - 8 in Fig. 7;

Fig. 9 is a perspective view showing a shutter in the fixing unit shown in Fig. 7;

Fig. 10 is a perspective view showing how to attach the shutter in the fixing unit shown in Fig. 7; and

5 Fig. 11 is a partly, perspective view showing the fixing unit which is attached with the shutter in Fig. 10

[0012]

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a broad sense, a fixing device which nips and transports  
10 a recording medium by a fixing nip part defined by a couple of rollers installed in a housing, and fuses and fixes an unfixed toner on a recording medium, is comprised of: a gripping part which is formed on the housing and may be gripped when the fixing device is handled; a medium introducing port which is formed  
15 near the gripping part of the housing, and to which a recording medium to be subjected to a fixing process is guided; and a shutter which is provided slanted at a given angle with respect to a gripping surface of the gripping part such that the shutter has a fulcrum at a part thereof closer to the gripping part at the  
20 medium introducing port, and is turnable to a position to close the medium introducing port while resisting the urging forces of urging means. With such a mechanical arrangement, when the user grips the fixing unit with his fingers to handle the fixing unit, the finger causes the shutter to turn to a position to  
25 close the medium introducing port. Accordingly, the finger

cannot enter the inside of the fixing unit and, hence, in handling the fixing unit, the user never touches the hot roller or rollers.

[0013]

Preferred embodiments of the invention will be described with reference to Figs. 1 through 11. In those figures, like or equivalent portions will be designated by like reference numerals, and duplicated description is omitted.

[0014]

An outline of an image forming apparatus 1 constructed according to the present invention will first be described. In the description to follow, the image forming apparatus 1 is an image forming apparatus employing the electrophotographic system, in particular, a tandem type of image forming apparatus which includes developing devices provided respectively for four basic color toners contributing to the color development of the color image, and in which four color images are superimposed one on another on a transfer body and collectively transferred onto the transfer body. It is evident that the present invention may be applied not only to the tandem type of image forming apparatus, but also to every type of image forming apparatus irrespective of the number of developing devices, and presence of intermediate transfer body.

[0015]

As seen from Fig. 1, charging devices 20a, 20b, 20c and 20d, an exposure unit 30, developing devices 40a, 40b, 40c and

40d, transfer devices 50a, 50b, 50c and 50d, and cleaning devices 60a, 60b, 60c and 60d are disposed around photosensitive member drums 10a, 10b, 10c and 10d, respectively. The charging devices 20a, 20b, 20c and 20d uniformly charge the surfaces of the photosensitive member drums 10a, 10b, 10c and 10d, respectively. The exposure unit 30 irradiate the surfaces of the charged photosensitive member drums 10a, 10b, 10c and 10d respectively with scanning lines 30K, 30C, 30M and 30Y of laser beams corresponding to image data of specific colors, whereby electrostatic latent images are formed on the surfaces of the photosensitive member drums. The developing devices 40a, 40b, 40c and 40d develop the electrostatic latent images formed on the photosensitive member drums 10a, 10b, 10c and 10d into toner images. The transfer devices 50a, 50b, 50c and 50d transfer the toner images that were developed on the photosensitive member drums 10a, 10b, 10c and 10d, onto an endless, intermediate transfer belt (intermediate transfer body) 70. The cleaning devices 60a, 60b, 60c and 60d remove toner left on the photosensitive member drums 10a, 10b, 10c and 10d after the toner images are transferred from the photosensitive member drums 10a, 10b, 10c and 10d onto the intermediate transfer belt 70.

[0016]

The exposure unit 30 is disposed while being slanted with respect to the photosensitive member drums 10a, 10b, 10c and 10d at a predetermined angle. The intermediate transfer belt

70 is rotated in a direction of an arrow A in the illustrated case. The image forming stations Pa, Pb, Pc and Pd form color images of black, cyan, magenta and yellow, respectively. The monicolor images of the respective colors having been formed  
5 on the photosensitive member drums 10a, 10b, 10c and 10d are superimposed one on another on the intermediate transfer belt 70 to thereby form a full color image.

[0017]

A sheet feed cassette 100 containing sheet materials  
10 (recording media) 90, such as printing sheets, is provided in a lower part of the image forming apparatus. The sheet materials 90 are transferred, sheet by sheet, from the sheet feed cassette 100 into a sheet transport path (recording medium transporting path) by a sheet feed roller 80.

15 [0018]

A sheet-material transport roller 110 and a fixing device  
120 are disposed along the sheet transport path. The sheet-material transport roller 110 contacts with the outer peripheral surface of the intermediate transfer belt 70 over  
20 a predetermined range of the surface, and transfers the color image that was formed on the intermediate transfer belt 70 onto the sheet material 90. The fixing device 120 fixes the color image, which has been transferred to the sheet material 90, onto the sheet material 90 under pressure and heat, which are caused  
25 by the nipping and rotation of the roller.



[0019]

The thus constructed image forming apparatus 1 first forms a latent image of a black component of the image information on the photosensitive member drum 10a, by cooperation of the charging device 20a in the image forming station Pa and the exposure unit 30. The latent image thus formed is visualized into a black toner image by use of the developing device 40a containing black toner, and is transferred onto the intermediate transfer belt 70 by use of the transfer device 50a.

10 [0020]

While the black toner image is transferred onto the intermediate transfer belt 70, a latent image of the cyan component is formed in the image forming station Pb, and subsequently a cyan toner image of the cyan toner is visualized by use of the developing device 40b. Then, the transfer device 50a of the image forming station Pb transfers the cyan toner image, in a superimposing manner, onto the black toner image on the intermediate transfer belt 70, which has undergone the transfer of the black toner image in the preceding image forming station Pa.

[0021]

Subsequently, a magenta toner image and a yellow toner image will be formed in similar manners. When the superimposing operation of the four color toner images on the intermediate transfer belt 70 is completed, the four color toner images are

collectively transferred, by the sheet-material transport roller 110, onto the sheet material 90 which has been fed from the sheet feed cassette 100 by the sheet feed roller 80. And, the toner image thus transferred is fused and fixed on the sheet material 90 by the fixing device 120, whereby a full color image is formed on the sheet material 90.

[0022]

Next, the fixing device used in the image forming apparatus 1 will be described.

10 [0023]

As shown in Fig. 2, the fixing device is made up of a heating roller 130, a fixing roller (roller) 140, an endless heat-resistance belt 150, and a pressure roller (roller) 160. The heating roller 130 is heated by electromagnetic induction by an induction heating unit 180. The fixing roller 140 is disposed parallel to the heating roller 130. The heat resistance belt 150 is stretched between the heating roller 130 and the fixing roller 140, heated by the heating roller 130, and rotated in a direction of an arrow B with the rotation of either of those rollers. The pressure roller 160 is pressed against the fixing roller 140 with the heat-resistance belt 150 being interposed therebetween, and is rotated in the forward direction with respect to the heat-resistance belt 150.

[0024]

25 The heating roller 130 consists of a hollowed, cylindrical

rotary body formed with a magnetic metallic member, such as iron, cobalt, nickel or an alloy of those metallic materials. The heating roller is 20mm in outside diameter, 03mm in thickness, low in thermal capacity, and high in temperature rising rate.

5 To impart the releasability to the heating roller, a release layer (not shown), which is made of fluororesin and has a thickness of 20 $\mu$ m, is formed over the surface of the heating roller.

[0025]

The fixing roller 140 includes a metallic core bar 140a  
10 made of stainless steel, for example, and an elastic member 140b which is formed with solid or foamed heat-resistance silicone rubber and covers the core bar 140a. To form a fixing nip part N of a predetermined width between the pressure roller 160 and the fixing roller 140 by use of a pressing force applied from  
15 the pressure roller 160, an outside diameter of the fixing roller is about 30mm, larger than that of the heating roller 130.

[0026]

The heat-resistance belt 150 stretched between the heating roller 130 and the fixing roller 140 is heated at a contact part  
20 W1 between the heat-resistance belt and the heating roller 130 heated by the induction heating unit 180. The inner surface of the heat-resistance belt 150 is continuously heated when the heating roller 130 and the fixing roller 140 are rotated, so that the belt is entirely heated.

25 [0027]

The pressure roller 160 includes a core bar 160a as a metallic cylindrical member which has good thermal conductivity and is made of copper or aluminum, and an elastic member 160b which is formed on the surface of the photosensitive member drum 10a, and has good heat resistance and good toner releasability. SUS other than the metallic material may be used for the core bar 160a.

[0028]

The induction heating unit 180 for heating the heating roller 130 by electromagnetic induction, as shown in Fig. 2, is disposed facing the outer peripheral surface of the heating roller 130. The induction heating unit includes an exciting coil 190 as a magnetic field generating means, and a coil guide plate 200 wound with the exciting coil 190.

[0029]

Temperature of a belt inner surface of the heat-resistance belt 150, which is heated by the induction heating unit 180, is detected by a temperature detecting device 170.

The temperature detecting device contains a thermosensitive element having a high thermal response, such as a thermistor, and is disposed in contact with the inner surface of the heat-resistance belt 150 at a position near the entrance of the fixing nip part N. Temperature of the heat-resistance belt 150 is stably kept at, for example, 180°C by using the detected temperature.

[0030]

As shown in Fig. 3, a gripping part 230a is formed as a part of the housing. The user grips the gripping part 230a when he detaches the fixing unit 230 from the image forming apparatus 1 and attaches it to the latter. The fixing unit 230 includes a couple of the fixing roller 140 and the pressure roller 160 which are for nipping and transporting the sheet material 90, the heat-resistance belt 150 and the heating roller 130. A medium introducing port 250 to which the sheet material 90 to be subjected to the fixing process is guided, is formed near the gripping part 230a of the fixing unit 230.

[0031]

A shutter 260 is provided at the medium introducing port 250. The shutter 260 is provided slanted at a given angle with respect to gripping surface 240 of the gripping part 230a such that the shutter has a fulcrum at a part of the shutter which is closer to the gripping part 230a. A couple of twisted springs 270 are provided on both ends of the shutter 260 and urge the shutter 260 in such a direction as to open the medium introducing port 250. The shutter 260 is turnable to a position where it closes the medium introducing port 250, while resisting the urging forces of the twisted springs 270. As shown in Figs. 9 and 11, hook parts 310 to which the twisted springs 270 are fixed are provided on both ends of the shutter.

[0032]

In a state that the fixing unit 230 is attached to the image forming apparatus 1, as shown in Figs. 4, 7, 8 and 11, the urging forces of the twisted springs 270 place the shutter 260 at such a position as to allow the medium introducing port 250 to open. In this state, the shutter 260 functions as a guide for guiding the sheet material 90 to the medium introducing port 250.

[0033]

When, to attach or detach the fixing unit 230 to or from the image forming apparatus 1, the user grips the gripping part 230a with his fingers, and his finger approaches the medium introducing port 250, the finger pushes and turns the shutter 260 down to a position to close the medium introducing port 250, so that the finger cannot enter the fixing unit through the medium introducing port 250. With such a structure, even if the user carelessly handles the fixing device, the user never touches the hot rollers 140 and 160. In the fixing unit 230, stoppers 300 are provided at parts which face both ends of the shutter 260. In a state that the shutter 260 closes the medium introducing port 250, both ends of the shutter 260 come in contact with the stoppers 300, so that the shutter 260 is prevented from turning beyond the medium introducing port and entering the fixing unit 230. With such a structure, when the user closes the shutter 260 while resisting the urging forces of the twisted springs 270, the shutter 260 surely closes the medium introducing

port 250.

[0034]

Here, the wording "to close the medium introducing port 250" involves a state that the medium introducing port 250 is not completely closed and also such an opening of the medium introducing port 250 as to prevent the finger gripping the housing 230 from entering the inside of the fixing unit.

[0035]

While the induction-basis fixing device using the induction heating unit 180 as the heat source is discussed in the embodiment mentioned above, it will readily be understood that another heat source, such as a halogen lamp, may be used for the heat source of the fixing device.

[0036]

As seen from the foregoing description, when the user grips the fixing unit with his fingers to handle the fixing unit, the finger causes the shutter to turn to a position to close the medium introducing port. Accordingly, the finger cannot enter the inside of the fixing unit and, hence, in handling the fixing unit, the user never touches the hot roller or rollers.

Further, the shutter serves also as the sheet guide. Accordingly, there is no need of providing a separate shutter in addition to the sheet guide. This leads to reduction of the number of component parts.